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INTEGRATED BIOLOGICAL STATUS OF SOUTHERN BRITISH COLUMBIA CHINOOK SALMON (*ONCORHYNCHUS TSHAWYTSCHA*) UNDER THE WILD SALMON POLICY

Chinook Salmon adult spawning phase. (Photo credit: Fisheries and Oceans Canada.)

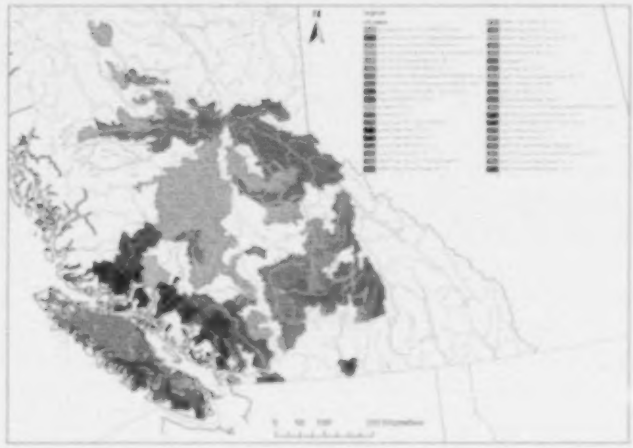

Figure 1. Map of southern BC showing the Chinook Conservation Units.

Context:

Canada's Wild Salmon Policy's (WSP) identifies six strategies for implementation. Strategy 1 is "Standardized monitoring of wild salmon status" and requires biological status assessments for all Pacific salmon conservation units (CUs). To conduct WSP status assessments, a toolkit comprised of a number of classes of indicators and metrics for status evaluation was completed in 2009. However, since a number of metrics can be used to evaluate biological status, it is possible that each metric can indicate a different status (Red, Amber, or Green). Therefore, status integration, which includes synthesis of CU status information across metrics into one or more status zones, and the provision of expert commentaries on the information used to assess status, is a useful final step in the status designation process. This report presents the application of WSP status integration conducted in a CSAS workshop. This workshop builds upon a previous application of WSP status integration techniques conducted for Fraser Sockeye CUs.

This Science Advisory Report is from the February 4-6, 2014 Assessment of Southern British Columbia Chinook Salmon Conservation Units, Benchmarks and Status. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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Canada

SUMMARY

- A workshop entitled "Assessment of Southern British Columbia Chinook Salmon Conservation Units, Benchmarks and Status" was conducted to determine an integrated Wild Salmon Policy (WSP) status for each of the 35 southern BC Chinook Salmon Conservation Units (CU). The status integration method used was similar to that applied to Fraser Sockeye (Grant & Pestal 2013). A characteristic of southern BC Chinook Salmon CUs that is distinct from the Sockeye Salmon CUs assessed so far is the significant presence of hatchery-origin fish in addition to wild-origin fish in many of the CU area/watersheds.
- For this workshop, multi-page standardized data summaries were produced for each southern BC Chinook Salmon CU. The data used to generate these summaries had been previously reviewed through two Regional Peer Review processes.
- Participants were asked to determine a single WSP status zone from Red (poor status) to Amber (cautious status) to Green (healthy status) for the CU based on a combination of the information from the individual status metrics.
- Status evaluations were completed and consensus reached on an integrated WSP status designation for 15 of the 35 CUs. Of these, 11 were assigned a Red status, one was assigned a Red/Amber status, one was assigned an Amber status and two were assigned a Green status. For another nine of the 35 CUs, an integrated status evaluation was not possible based on the information presented at the workshop. For these CUs, the status designation is "data deficient" and this designation is not expected to change until more information becomes available. For the remaining 11 of the 35 CUs, status evaluations were not completed. Instead, the status of these CUs was classified as "to be determined". These CUs are a component of units where the enhanced sites are predominant; consensus was not reached on how to derive a WSP status assessment for such units.
- In addition to providing final integrated status for each CU, the expert interpretation of the data summaries was documented in status commentaries. These commentaries provide the details underlying the final integrated status decisions. Status zones on their own do not provide an indication of which factors drive their designation, which would influence subsequent WSP strategies. The commentaries are an important source of information to inform management considerations.
- The designation of seven Fraser River CUs as Red and two others with a status of Amber is especially noteworthy. A review of all Chinook populations in BC carried out more than 30 years ago found compelling evidence of substantial declines in abundance in all geographic regions, except within the Fraser River watershed. The last 12 to 15 years have been a period during which most groups of Chinook within the Fraser River have declined in numbers, and the outlook for Chinook outside of the Fraser River has generally not shown sustained improvement since the earlier review.
- Integrated WSP status designations could not be developed for 20 of the 35 southern BC Chinook CUs based on the information and methods available to the workshop participants, which is very concerning. This highlights the need for additional work relating to information collection and assembly and for the development of a suitable method for status assessment when there is a significant contribution to recruitment and spawner abundance from enhanced sites.
- A proposal on the frequency of status re-assessments was agreed to: DFO staff should recalculate the individual status metrics annually, update the standardized data summaries,

and check for any substantial changes. If results from individual metrics indicate a change that could affect the overall status for the CU, a meeting would be convened to address the affected CUs only. A full re-assessment of all CUs would take place every four years.

INTRODUCTION

The goal of the Wild Salmon Policy (WSP) is to "restore and maintain healthy salmon populations and their habitats for the benefit and enjoyment of the people of Canada in perpetuity" (DFO 2005). In order to achieve this goal, the WSP outlines a number of strategies, including Strategy 1 (Standardized Monitoring of Wild Salmon Status), which is the subject of this Science Advisory Report (SAR). Action Steps for Strategy 1 include:

1. identification of CUs;
2. development of criteria to assess CUs and identification of benchmarks to represent biological status; and,
3. monitoring and assessment of CU status.

Work on these action steps has progressed since the WSP was published in 2005, with the following peer-reviewed milestones:

- method for the identification of Pacific salmon CUs (Holtby & Ciruna 2007);
- method for the assessment of Pacific salmon biological status under the WSP (Holt *et al.* 2009);
- technical background for WSP status assessments (Holt 2009; Porszt 2009; Holt 2010; Holt & Bradford 2011; Porszt *et al.* 2012);
- integration techniques for WSP status assessments of salmon CUs (Grant & Pestal 2013);
- revision of southern BC Chinook Conservation Unit assignments (DFO 2013).

Four classes of indicators have been recommended to evaluate WSP status of wild Pacific salmon: abundance, trends in abundance, distribution, and fishing mortality (Holt *et al.* 2009). Within each class of indicator, one or more metrics can be used for status assessments, and, for each metric, a lower benchmark and upper benchmark delineate the Red to Amber and Amber to Green status zones, respectively (Table 1). These biological benchmarks are specifically used for status assessments, and are not prescriptive for specific management actions. They are also designed to be more conservative than the criteria established by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), as required by the WSP.

Table 1. The three zones of biological status defined in the WSP (Grant & Pestal 2013).

Status	Definition
Red	"... established at a level of abundance high enough to ensure there is a substantial buffer between it and any level of abundance that could lead to a CU being considered at risk of extinction by COSEWIC"
Amber	"While a CU in the Amber zone should be at low risk of loss, there will be a degree of lost production. Still, this situation may result when CUs share risk factors with other, more productive units"
Green	"identif[ies] whether harvests are greater than the level expected to provide on an average annual basis, the maximum annual catch for a CU, given existing conditions...there would not be a high probability of losing the CU"

Since CU status evaluations can include more than one metric, it is possible that different metrics could each indicate a different WSP status zone from Red (poor status) to Green (healthy status). For example, the WSP recent trend in abundance metric could suggest a CU's status is poor, while conversely, the long-term trend metric could indicate the same CU's status is healthy. In cases where metric information is contradictory, provision of this metric-specific status information alone does not provide compiete scientific advice to fisheries management. Instead, a final step that synthesizes all metric and status-related information into an integrated status for each CU, and provides expert commentary on this information, is necessary as inputs into subsequent implementation of WSP Strategy 4 (Integrated Strategic Planning) to prioritize assessment activities and management actions (Table 2. Guidance in the WSP on assessment actions and management considerations for CUs in each of three status zones (Grant & Pestal 2013).Table 2).

Table 2. Guidance in the WSP on assessment actions and management considerations for CUs in each of three status zones (Grant & Pestal 2013).

Status	Assessment Actions	Management Considerations
Red	"... a detailed analytical assessment will normally be triggered to examine impacts on the CU of fishing, habitat degradation, and other human factors, and evaluate restoration potential", "... detailed stock assessments will identify the reasons for the change in status". "CUs in the Red zone ... will be identified as management priorities ... the protection and restoration of these CUs will be primary drivers for harvest, habitat, and enhancement planning."	"Biological considerations will be the primary driver for the management of CUs with Red status". "The presence of a CU in the Red zone will initiate immediate consideration of ways to protect the fish, increase their abundance, and reduce the potential risk of loss".
Amber	"... a detailed analytical assessment may be required to input into Strategies 2 & 3.."	"Decisions about the conservation of CUs in the Amber zone will involve broader considerations of biological, social, and economic issues"; "involves a comparison of the benefits from restoring production versus the costs arising from limitations imposed on the use of other CUs to achieve that restoration"; "implies caution in the management of the CU"
Green	" a detailed analytical assessment of its biological status will not usually be needed"	"Social and economic considerations will tend to be the primary drivers for the management of CUs in the green zone, though ecosystem or other non-consumptive values could also be considered".

For Pacific Salmon CUs, WSP biological status integration methods have previously been developed and applied to Sockeye Salmon assessments (Grant & Pestal 2013). However, a characteristic of southern BC Chinook Salmon CUs that is distinct from the Sockeye Salmon CUs assessed so far is that many areas support substantial numbers of hatchery-origin fish in addition to wild-origin fish. Therefore, the guidelines developed for Sockeye Salmon are only partially applicable to the southern BC Chinook Salmon situation. In order to explore the applicability of the status integration techniques developed previously, and to provide WSP

status assessments, a CSAS workshop entitled "Assessment of Southern British Columbia Chinook Salmon Conservation Units, Benchmarks and Status" was conducted to achieve these goals. This SAR summarizes the results from this CSAS workshop.

The objectives of the workshop were to:

1. Determine an integrated WSP status for each southern BC Chinook Salmon CU;
2. Indicate the effect on the status assessments of including, or excluding, enhanced Chinook Salmon contributions;
3. Provide advice on data and methods required for assessing the status of any CUs that are currently data deficient;
4. Include information specific to each CU on fishing mortality, where possible;
5. Provide advice on the appropriate frequency of status re-assessment, changes to monitoring variables that could invoke early re-assessment, and the appropriate timing for assessment relative to data availability; and
6. Identify and recommend data management approaches required to support recommended changes to re-assessment of CUs.

ASSESSMENT

Data

For this workshop, multi-page standardized data summaries were produced for each southern BC Chinook Salmon CU. The data used to generate these summaries had been previously reviewed through two CSAS Regional Peer Review processes[1,2]. These data summaries included the following:

- time series plots of spawner abundances (either relative indices or absolute abundances, where available);
- a table of absolute abundances relative to COSEWIC criteria D1 for small populations;
- a summary of overall data quality (as a percentage of spawner abundance);
- a summary of the categorization of enhancement activity level by census site[3];

[1]Brown, G.S., Baillie, S.J., Thiess, M.E., Bailey, R.E., Candy, J.R., Parken, C.K., and Willis, D.M. 2014. Pre-COSEWIC Review of Southern British Columbia Chinook Salmon (*Oncorhynchus tshawytscha*) Conservation Units: Part I, Background. CSAS Working Paper 2012/P62. In revision.

[2] Brown, G.S., Baillie, S.J., Bailey, R.E., Candy, J.R., Holt, C.A, Parken, C.K., Pestal, G.P., Thiess, M.E., and Willis, D.M. 2014. Pre-COSEWIC Review of Southern British Columbia Chinook Salmon (*Oncorhynchus tshawytscha*) Conservation Units, Part II: Data, Analysis and Synthesis. CSAS Working Paper 2012/13 P23. In revision.

[3] The concepts of a "Total Unit" (TU) and an Enhancement Unit (EU) were introduced at the workshop. A Total Unit can be comprised of two components: the CU and an associated EU. The CU includes only census sites with low or unknown enhancement level activity in an attempt to be consistent with the WSP focus on 'wild salmon'. The EU contains only census sites with moderate or high enhancement level activity. Although these concepts were introduced at the workshop, they were not endorsed by the participants and therefore are not considered to form a viable conceptual approach to this issue.

- a stacked bar plot illustrating the distribution of spawner abundance across sites within the CU;
- a whisker plot illustrating short term trends by census site within the CU;
- a table of spawner abundance by census site within the CU;
- status information for up to three WSP metrics: one metric for abundance relative to biological benchmarks, one metric for extent of decline in abundance, and two related metrics for short-term trend in abundance;
- where available, supplementary time series plots of natural log-transformed spawner abundance, generational average of spawner abundance, CWT indicator spawner abundance, total return, productivity (recruits/spawner by brood year), hatchery releases from within and outside the CU, exploitation rates and marine survival;
- retrospective (historical) time series of status for each WSP metric relative to established benchmarks (Holt *et al.* 2009).

Methods

Workshop participants were invited to attend based on their experience with different aspects of salmon assessment and included DFO staff from Science, Ecosystems Management and Fisheries Management sectors and external participants from First Nations organizations, the commercial and recreational fishing sectors, environmental non-governmental organizations, and academia. Participants were requested to join one of four pre-workshop seminars in order to review the data summary layout and to provide feedback to organizers on the workshop format. At the workshop, participants were assigned to one of six groups, each comprised of six or seven individuals. Their group assignment remained the same for the duration of the workshop. Individuals were assigned in order to provide a varied mix of views and expertise within each group.

Each of the 35 CUs (and their associated enhanced sites where applicable) was designated as an individual case study. The identity of the CU represented by a case study was not revealed to the participants during the initial assessment sessions. This "blind" approach was similar to that employed by Grant & Pestal (2013) during the Fraser Sockeye workshop. The 35 case studies were presented in seven sets over the first two days of the workshop. Participant groups were given 15 minutes, 30 minutes, one hour or 1.5 hours, depending on the set size and complexity, to discuss each set in a breakout session. At the end of each breakout session, back in a full participant plenary session, groups compared results and discussed their reasoning for their final integrated status designations. All of the 35 CUs were evaluated by at least some of the groups, and each group evaluated a representative number of CU types (different metrics and statuses). Late on the second day, the CU identity of each case study was revealed to the participants. The third day of the workshop was a full day of plenary discussion to reconcile group integrated status results allowing for use of knowledge of the identity of each CU.

Results

Final Integrated Status

By the end of the workshop, participants completed status evaluations and reached consensus on an integrated WSP status designation for 15 of the 35 CUs (Table 3 and Figure 2). The 15 southern BC Chinook CUs are ordered in Table 3 using their final integrated status, with CUs designated Red (poorest status) located at the top of the table to CUs designated Green (best

status) at the bottom. Thirteen out of the 15 CUs were reconciled between groups in the post-reveal plenary session to a single WSP status zone. There was one CU where final integrated statuses included two status zones. The Lower Fraser River_FA_0.3 (CK-03) CU's integrated Green status was flagged as provisional by participants. Following the example of the Fraser Sockeye WSP status assessments (Grant & Pestal 2013), when some participants held divergent views, the status assignment was classified as "provisional". In this case, the short-term decline observed in recent years, despite decreasing exploitation rate, resulted in a provisional status designation to highlight the need for monitoring the trend.

For another nine of the 35 CUs, an integrated status evaluation was not possible based on the information presented at the workshop. For these CUs, the status designation is "data deficient" (DD). When preparing the data summaries, the workshop organizers identified five CUs as obviously data deficient (Table 3, Cases 31 to 35). The workshop participants supported this initial assessment and also designated an additional four CUs as data deficient. For all nine of these CUs, the status designation is not expected to change until more information is available.

South Thompson-Bessette Creek_SU_1.2 (CK-16) and Okanagan_1.x (CK-01) were designated as Red status. However, there was some concern expressed by the participants that the definition of these CUs might not be valid. The status of these CUs should be re-evaluated following a review of their CU definitions.

The remaining 11 of the 35 CUs (Table 4) presented a substantial challenge for the participants and ultimately, status evaluations could not be completed for them. Instead, the status of these CUs was classified as "to be determined" (TBD). These CUs are geographically proximate to predominantly enhanced sites, or data exist only for the enhanced sites geographically proximate to the CU (e.g. a CU may exist but no wild census sites have data of sufficient quality for assessment at this time). Consensus was not reached on how to derive a WSP status assessment for such combined wild and enhanced site units, or the CUs that spawn in the same area. A method to consider enhanced contribution by redefining the wild site versus enhanced site classification in the data summaries was proposed by the workshop organizers. However; there was consensus that a review of the proposed method was not within the scope of the workshop and should be the subject of a future review. Although there are no status evaluations provided for these 11 CUs, unlike the situation with the data deficient CUs, an integrated WSP status could be determined in some cases once a suitable method is developed to assess the status of enhanced sites and how they should be considered in status assessments of the CU.

Status Commentaries

In addition to documenting a final integrated status designation for each CU, the expert interpretation of the data summaries was recorded as status commentaries (Appendix B of the Research Document resulting from the workshop). These commentaries provide the details underlying the final integrated status decisions, which varied even amongst CUs with identical status designations. These details will be important when the results from Strategy 1 (Standardized Monitoring of Wild Salmon Status) are linked to Strategy 4 (Integrated Strategic Planning). Status zones on their own do not provide an indication of which factors drive their designation, which would influence subsequent WSP strategies. The commentaries are an important source of information to inform management considerations.

Table 3. Summary of completed integrated status evaluations for Southern BC Chinook Salmon CUs.

Integrated status evaluation completed at workshop

Integrated Status	Case #	CU ID	CU Name	Area
RED	1	CK-10	Middle Fraser River_SP_1.3	Fraser
RED	4	CK-18	North Thompson_SP_1.3	Fraser
RED	6	CK-19	North Thompson_SU_1.3	Fraser
RED	11	CK-09	Middle Fraser River-Portage_FA_1.3	Fraser
RED	24	CK-17	Lower Thompson_SP_1.2	Fraser
RED	25	CK-31	West Vancouver Island-South_FA_0.x	WCVI
RED	26	CK-12	Upper Fraser River_SP_1.3	Fraser
RED	29	CK-29	East Vancouver Island-North_FA_0.x	Inner SC
RED	30	CK-32	West Vancouver Island-Nootka & Kyuquot_FA_0.x	WCVI
RED*	3	CK-16	South Thompson-Bessette Creek_SU_1.2	Fraser
RED*	5	CK-01	Okanagan_1.x	Columbia
RED / AMBER	27	CK-14	South Thompson_SU_1.3	Fraser
AMBER	12	CK-11	Middle Fraser River_SU_1.3	Fraser
GREEN(p)	9	CK-03	Lower Fraser River_FA_0.3	Fraser
GREEN	2	CK-13	South Thompson_SU_0.3	Fraser

Integrated status evaluation not possible based on information presented at workshop

Integrated Status	Case #	CU ID	CU Name	Area
DD	7	CK-82	Upper Adams River_SU_x.x	Fraser
DD	8	CK-06	Lower Fraser River_SU_1.3	Fraser
DD	10	CK-05	Lower Fraser River-Upper Pitt_SU_1.3	Fraser
DD	28	CK-28	Southern Mainland-Southern Fjords_FA_0.x	Inner SC
DD	31	CK-08	Middle Fraser-Fraser Canyon_SP_1.3	Fraser
DD	32	CK-20	Southern Mainland-Georgia Strait_FA_0.x	Inner SC
DD	33	CK-34	Homathko_SU_x.x	Inner SC
DD	34	CK-23	East Vancouver Island-Nanaimo_SP_1.x	Inner SC
DD	35	CK-35	Klinaklini_SU_1.3	Inner SC

"(p)" means provisional, and identifies cases where some participants held divergent views.
"*" means that CU definition should be reviewed.

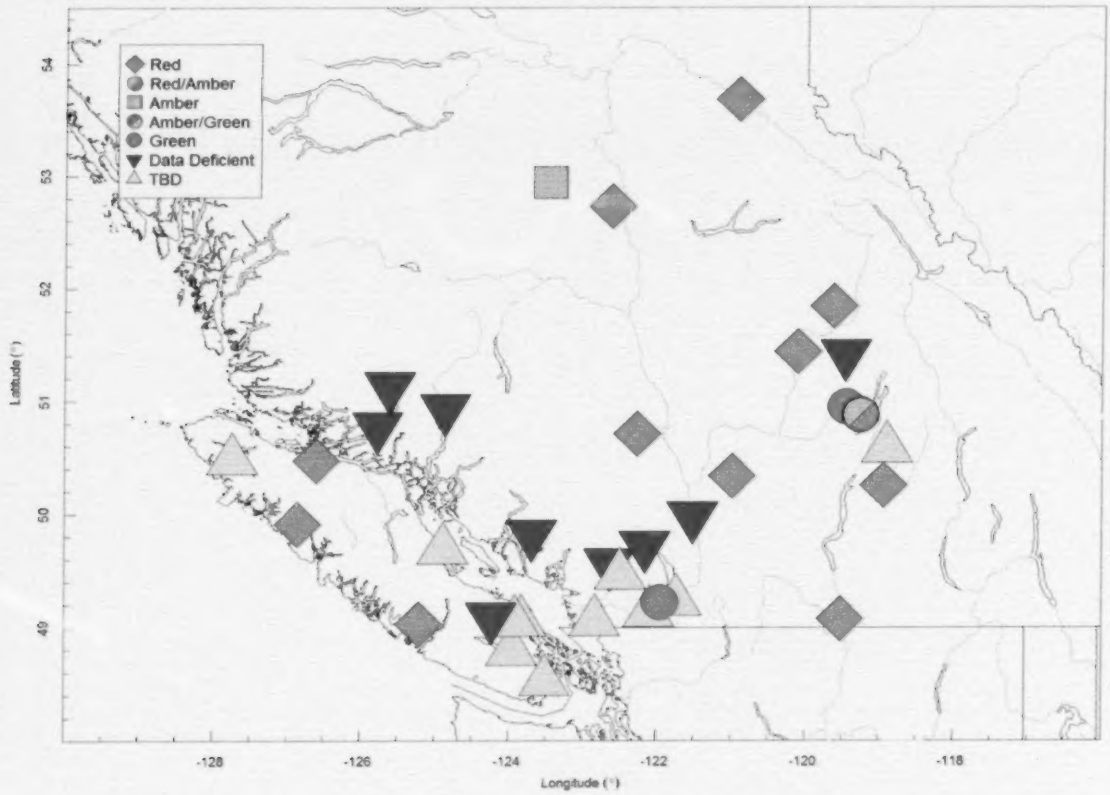

Figure 2. Map of southern BC summarizing workshop consensus on biological status of southern BC Chinook Salmon CUs.

Status Integration Approaches

The workshop organizers had prepared an initial set of guidelines for status integration (see Appendix E of the Proceedings resulting from the workshop). These guidelines were largely based on the recommendations in Grant and Pestal (2013). After the groups had completed several evaluations they reported that they were adopting patterns in their approach to status integration. Based on the feedback from participants, the guidelines were revised and are reported in Section 3 of the Research Document resulting from the workshop. In addition, the status deliberation notes and plenary discussions exposed some common themes to status integration approaches that were not explicitly endorsed as guidelines by the participants. These are also documented in Section 3 of the Research Document resulting from the workshop.

Table 4. Summary of incomplete integrated status evaluations for Southern BC Chinook Salmon CUs.

Integrated status evaluation not attempted at workshop due to unresolved methods

Integrated Status	Case #	CU ID	CU Name	Area
TBD**	13	CK-04	Lower Fraser River_SP_1.3	Fraser
TBD	14	CK-21	East Vancouver Island-Goldstream_FA_0.x	Inner SC
TBD	15	CK-33	West Vancouver Island-North_FA_0.x	WCVI
TBD	16	CK-22	East Vancouver Island-Cowichan & Koksilah_FA_0.x	Inner SC
TBD	17	CK-02	Boundary Bay_FA_0.3	Inner SC
TBD	18	CK-07	Maria Slough_SU_0.3	Fraser
TBD	19	CK-25	East Vancouver Island-Nanaimo & Chemainus_FA_0.x	Inner SC
TBD	20	CK-15	Shuswap River_SU_0.3	Fraser
TBD	21	CK-83	East Vancouver Island-Georgia Strait_SU_0.3	Inner SC
TBD	22	CK-27	East Vancouver Island-Qualicum & Puntledge_FA_0.x	Inner SC
TBD	23	CK-9008	Fraser-Harrison fall transplant_FA_0.3	Fraser

"**" means that CU status should be re-evaluated after review of enhancement level definition.

Sources of Uncertainty

- The standardized data summaries were prepared based on data that had been previously reviewed[1,2], however, these summaries are based largely on spawner data with a substantial but unquantified level of uncertainty.
- A period of apparent abundance increases occurred during the 1990s and early 2000s when major improvements were made in many BC escapement programs. These escapement estimation improvements typically resulted in immediate and noticeably higher annual estimates relative to earlier estimates. This suggests that apparent improvements in abundance could be related more to changes in survey and estimation methods than to genuine biological changes.
- Some of the abundance time series represent relative rather than absolute abundances. Relative abundances likely under-estimate true abundance (by unknown and variable amounts), so an indication of red zone status in relation to the WSP metric on absolute abundance may not be accurate.
- Some of the individual metrics display a pattern of changing status from one year to the next (e.g. red status one year followed by green status the next year and then returning to red). In this situation, the metric is not conveying meaningful results for determining integrated status and would typically be disregarded or given less weight in status deliberations.
- Information on the contribution of enhanced fish to the abundance of fish observed at "wild" sites is often limited; and as such, the actual wild contribution (which is key to the WSP CU definition) is often unknown. For the purposes of these status assessments, observations at wild sites are assumed to be comprised entirely of wild fish.
- The status evaluations developed at this workshop ultimately relied on the expert opinions of the participants and as such, are subject to the experience and opinions of the individuals involved. Because many of the evaluations are more subjective than objective, the

repeatability of these findings is uncertain. The status commentaries in Appendix B of the Research Document resulting from the workshop identify cases where participants were especially confident in their assessment, as well as cases where the status designations were particularly uncertain, which may be useful in developing approaches to quantifying this uncertainty in the future.

CONCLUSIONS AND ADVICE

Southern BC Chinook CUs Integrated Status

Integrated status designations were developed for 15 of the 35 southern BC Chinook CUs, and status commentaries were provided for all 35 CUs. In some cases, the commentaries provide more useful advice for management considerations than would be indicated by the mapping of the status zone to the management considerations in Table 2. These results address two of the six objectives for the workshop: "determine an integrated WSP status for each southern BC Chinook Salmon CU", and "include information specific to each CU on fishing mortality, where possible".

The majority of CUs for which an integrated status was developed occurred within the Fraser River watershed (11 of 15). This reflects the reduced prevalence of enhancement as a management intervention in that region. While seven of the Fraser River CUs were designated as Red, all four of the CUs that were assessed from other regions were also designated as Red. All adult and juvenile life history patterns known in southern BC Chinook are represented in the group of 11 Red status CUs. This suggests that declines in abundance shown by these CUs cover a broad geographic area and are not specific to any particular group of Chinook Salmon.

The designation of seven Fraser River CUs as Red and two others with a status of Amber is especially noteworthy. A review of all Chinook populations in BC carried out by Healey (1982) more than 30 years ago found compelling evidence of substantial declines in abundance in all geographic regions, except within the Fraser River watershed. Riddell *et al.* (2013) suggested that spawner abundances in most southern BC areas may have increased for a period in the 1990s and early 2000s. However, these apparent improvements in abundance could be related more to changes in survey and estimation methods than to genuine biological changes. Regardless of whether real abundance increases occurred in the 1990s, the last 12 to 15 years have been a period during which most groups of Chinook within the Fraser River have declined in numbers. The outlook for Chinook Salmon outside of the Fraser River has generally not shown sustained improvement since Healey's (1982) review.

Recommendations

- Integrated status designations could not be developed for 20 of the 35 southern BC Chinook CUs based on the information and methods available to the workshop participants. This represents the majority of the southern BC Chinook CUs, or approximately 21% of the surveyed aggregate abundance, which is a concern. This highlights the need for additional work and relates to the objectives: "provide advice on data and methods required for assessing the status of any Conservation Units that are currently data deficient", and "identify and recommend data management approaches required to support recommended changes to re-assessment of CUs".
- In some cases, additional information relating to the data deficient CUs is in the possession of the Department, but has not yet been incorporated into the regional escapement data holdings where it would be accessible to analysts. If this information were incorporated, it is possible that some of the CUs would no longer be data deficient and status designations could be developed. This information includes escapement survey records held by local

offices in paper and electronic formats that have not been a priority for further analysis to date. The work necessary to locate and incorporate this information into the regional escapement data holdings could provide significant benefits for future status assessments.

- The workshop participants identified an issue where a Chinook population is known anecdotally to exist, but there are no escapement surveys recorded in the regional escapement data holdings. Examples of this are information from local traditional knowledge, data from non-DFO programs such as fish habitat surveys initiated for forestry purposes, and data from juvenile salmon surveys. Since the regional adult escapement data holdings provided the source information for initial CU definition, the absence of survey records meant that these populations were not included in the CU definitions. Thus it is possible that there are additional Chinook CUs yet to be defined. These would likely form additional CUs for the data deficient category. This issue could be addressed by incorporating the information on un-surveyed but known Chinook populations into the regional escapement data holdings as placeholder records.
- The amount of data filtered out due to data quality concerns prior to status assessments raises questions regarding the utility of temporally extensive, low-quality surveys and their role in the stock assessment program should be reviewed. If such data are not useful for status assessment, then they are of little value other than indicating fish presence which has proved useful only in identifying spawning sites for potential grouping within a CU.
- Aside from the data deficiency issue, the other issue which prevented integrated status designations relates to the workshop objective: "indicate the effect on the status assessments of including and excluding enhanced Chinook Salmon, where applicable". This was the only objective of the workshop that was not successfully addressed. The participants attempted to address this objective but the consensus was that given the methods and guidelines available to them, status designation was not possible for CUs that had a substantial contribution from enhanced sites. To resolve this issue for future assessments would require a specific project to develop a suitable method for status assessment for sites (or groups of sites) with significant enhancement contribution. In addition, guidance would need to be developed for considering the interaction between the CU and an associated enhanced contribution in the status assessment of the CU. The resulting proposed method and guidelines should then be subject to peer review. Once this work is complete, the southern BC Chinook CUs currently categorized with a status of To Be Determined should be re-assessed.

Status Integration Process

Again, similar to the approach taken for Fraser Sockeye Salmon CUs (Grant & Pestal 2013), expert opinion on status integration and associated commentaries were elicited through a combination of smaller breakout groups and full participant plenary sessions. The advantage of this approach was that it permitted independent small-group evaluation of a range of integration approaches and integrated status designations, which could then be consolidated in a plenary session with all participants. Although not highlighted in the results presented here, more often than not, the individual group results showed a similar status designation for a CU and the status reconciliation during the plenary session was rapid and not controversial. This provides some confidence that the integration process is more objective than subjective, and is repeatable.

Integration Guidelines

Now that two of these larger integration workshops have occurred, and a variety of CUs have been examined, it might be possible to prepare a more comprehensive set of integration guidelines for formal peer-review. Once accepted, these guidelines could allow for the completion of a preliminary status integration report for a collection of CUs by a small expert team. This report would then become the working paper to be reviewed via the more typical CSAS Regional Peer Review process. If this work were undertaken it would help to address the concern that the workshop format for WSP status assessment is onerous and is limiting the opportunity for status assessments.

Frequency of Re-Assessment

A key workshop objective was to "provide advice on the appropriate frequency of status re-assessment, changes in monitoring variables that could invoke early re-assessment, and appropriate timing for assessment relative to data availability". The following proposal on the frequency of status re-assessments was agreed on by participants in plenary session.

- DFO staff should recalculate the individual status metrics annually, update the standardized data summaries, and check for any substantial changes.
- A meeting would not be required to re-assess status of CUs unless results from individual metrics indicated a change that could affect the overall status for the CU.
- A shorter (and perhaps smaller) meeting would be convened to address the affected CUs only.
- A full re-assessment of all CUs would take place every four years (representing approximately once per generation for most Chinook CUs).
- Full re-assessment meetings would include representation from DFO and stakeholders, but could be shorter than the current workshop; the meeting could review a status assessment working paper, and could possibly be vetted through a CSAS Science Response process instead of a Regional Peer Review process.

SOURCES OF INFORMATION

This Science Advisory Report is from the February 4-6, 2014 Assessment of Southern British Columbia Chinook Salmon Conservation Units, Benchmarks and Status. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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MPO. 2016. État biologique intégré du saumon quinnat (oncorhynchus tshawytscha) du sud de la Colombie-Britannique en vertu de la politique concernant le saumon sauvage. Secr. can. de consult. sci. du MPO, Avis sci. 2016/042.